

Claims

1. Method for digitally encoding (10 - 19) a picture sequence, wherein the frames (FRM) of said picture sequence are arranged in macroblocks (MB) containing pixel blocks and the frames are encoded in bi-directionally-predictive and predictive and/or intra coding types denoted B, P and I, respectively, and wherein adaptively, for the purpose of overall bit rate control, a specific frame target number of bits is assigned to each one of these coding types, and wherein said overall bit rate control includes a frame-layer rate control and a macroblock-layer rate control which macroblock-layer rate control selects macroblock quantisation parameters, said method including the steps:
- assigning (10) a target number of bits to anchor frames only, or to each group of frames consisting of a single anchor frame and at least one non-anchor frame;
  - coding anchor frames (P, I) using macroblock-layer rate control (10) by adaptive macroblock quantisation (12) parameters, and coding non-anchor frames (B) without macroblock-layer rate control (10) by using fixed macroblock quantisation (12) parameters.
2. Apparatus for digitally encoding (10 - 19) a picture sequence, wherein the frames (FRM) of said picture sequence are arranged in macroblocks (MB) containing pixel blocks and the frames are encoded in bi-directionally-predictive and predictive and/or intra coding types denoted B, P and I, respectively, and wherein adaptively, for the purpose of overall bit rate control, a specific frame target number of bits is assigned to each one of these coding types, and wherein said overall bit rate control includes a frame-layer rate control and a macroblock-layer rate control which macroblock-layer rate control selects macroblock quantisation parameters, said apparatus includ-

ing:

- means (10) for assigning a target number of bits to anchor frames only, or to each group of frames consisting of a single anchor frame and at least one non-anchor frame;
  - means (11 - 18) for coding anchor frames (P, I) using macroblock-layer rate control (10) by adaptive macroblock quantisation (12) parameters, and for coding non-anchor frames (B) without macroblock-layer rate control by using fixed macroblock quantisation (12) parameters.
3. Method according to claim 1 or apparatus according to claim 2, wherein the quantisation (12) parameter used for the coding of non-anchor frames in a current group of frames is directly derived (10) from the average quantisation (12) parameter of the previously encoded anchor frame belonging to that group.
4. Method or apparatus according to one of claims 1 to 3, wherein for the bit rate control for the anchor and non-anchor frames inside a current one of said groups a weighting factor  $f_{\text{Group-BP}}$  or  $f_{\text{Group-I}}$  is used, which weighting factors are adaptively controlled during the encoding of said picture sequence and specify the estimated ratios of the number  $R_{\text{NA}}$  of bits used for encoding a non-anchor frame to the number  $R_{\text{A-BP}}$  of bits required for encoding an anchor frame if it is coded as P or B frames, or  $R_{\text{A-I}}$  if it is coded as I-frame:

$$f_{\text{Group-BP}} = \frac{R_{\text{NA}}}{R_{\text{A-BP}}}, \quad f_{\text{Group-I}} = \frac{R_{\text{NA}}}{R_{\text{A-I}}} .$$

5. Method or apparatus according to claim 4, wherein for initialisation at the beginning of encoding a picture sequence said weighting factors  $f_{\text{Group-BP}}$  and  $f_{\text{Group-I}}$  are set to:

$$f_{\text{Group-BP}} = \frac{1}{2}, \quad f_{\text{Group-I}} = \frac{1}{10} \quad .$$

6. Method or apparatus according to claim 4 or 5, wherein based on a number  $\hat{R}_{\text{Group-BP}}$  or  $\hat{R}_{\text{Group-I}}$  of target bits for a current one of said groups, the frame target bit number  $\hat{R}_{A-BP}$  or  $\hat{R}_{A-I}$  for the anchor frame is:

$$\hat{R}_{A-BP} = \frac{\hat{R}_{\text{Group-BP}}}{(1 + N_{NA} \cdot f_{\text{Group-BP}})} \quad \text{or} \quad \hat{R}_{A-I} = \frac{\hat{R}_{\text{Group-I}}}{(1 + N_{NA} \cdot f_{\text{Group-I}})} \quad , \quad \text{respectively,}$$

wherein  $N_{NA}$  denotes the number of non-anchor frames inside that current group, and whereby a corresponding accurate macroblock-layer rate control is used.

7. Method or apparatus according to one of claims 4 to 6, wherein the non-anchor frame or frames of a current one of said groups are encoded using a fixed quantisation step size of  $Q_{NA} \approx 1.2 \cdot \overline{Q_A}$ , where  $\overline{Q_A}$  denotes the average quantisation step size that was used for encoding the anchor frame of that group.

8. Method or apparatus according to one of claims 4 to 7 wherein, after a current one of said groups has been encoded completely, said weighting factors  $f_{\text{Group-BP}}$  and  $f_{\text{Group-I}}$  are updated in that weighting factors for said current group are determined by

$$\tilde{f}_{\text{Group-BP}}(n_{\text{Group-BP}}) = \frac{1}{N_{NA} \cdot R_{A-BP}} \cdot \sum_{k=1}^{N_{NA}} R_{NA}(k) \quad \text{or}$$

$$\tilde{f}_{\text{Group-I}}(n_{\text{Group-I}}) = \frac{1}{N_{NA} \cdot R_{A-I}} \cdot \sum_{k=1}^{N_{NA}} R_{NA}(k) \quad , \quad \text{respectively,}$$

wherein  $R_{NA}(k)$  is the number of used bits for the k-th non-anchor frame inside said current group,  $R_{A-BP}$  and  $R_{A-I}$  are the number of bits used for encoding the anchor frames as P/B-frame or as I-frame, respectively, and  $n_{\text{Group-BP}}$  and  $n_{\text{Group-I}}$  are continuously increasing indi-

ces for said weighting factors,  
 and wherein the weighting factors to be used for follow-  
 ing groups are each calculated as corresponding average  
 values of the weighting factors used for several, e.g.  
 5 five, of the last encoded groups.

9. Method or apparatus according to claim 4 wherein, if In-  
 tra frames are coded rarely, both said weighting factors  
 $f_{\text{Group-BP}}$  and  $f_{\text{Group-I}}$  are updated at the same time by  
 10 using an adaptively controlled weighting factor  $f_{\text{BP-I}} =$   
 $R_{\text{A-BP}}/R_{\text{A-I}}$ , which specifies the estimated bit-rate ratio  
 of anchor frames coded as P/B-frames and anchor frames  
 coded as I-frames, such that  $f_{\text{Group-I}} = \frac{f_{\text{Group-BP}}}{f_{\text{BP-I}}}$ .

- 15 10 Method for digitally decoding an encoded picture se-  
 quence, wherein the frames (FRM) of said picture sequence  
 are arranged in macroblocks (MB) containing pixel blocks  
 and the frames were encoded in bi-directionally-predic-  
 tive and predictive and/or intra coding types denoted B,  
 20 P and I, respectively, and wherein adaptively, for the  
 purpose of overall bit rate control, a specific frame  
 target number of bits was assigned to each one of these  
 coding types, and wherein said overall bit rate control  
 included a frame-layer rate control and a macroblock-  
 25 layer rate control which macroblock-layer rate control  
 had selected macroblock quantisation parameters,  
 wherein a target number of bits was assigned to anchor  
 frames only, or to each group of frames consisting of a  
 single anchor frame and at least one non-anchor frame,  
 30 and wherein anchor frames (P, I) were coded using macro-  
 block-layer rate control (10) by adaptive macroblock  
 quantisation (12) parameters, and non-anchor frames (B)  
 were coded without macroblock-layer rate control (10) by  
 using fixed macroblock quantisation (12) parameters,  
 35 said method including the step of:

- decoding said anchor frames (P, I) using correspondingly adaptive macroblock quantisation parameters, and decoding said non-anchor frames (B) using fixed macroblock quantisation parameters.